Mimicking turf-toe: myofasopathy of the first dorsal interosseous muscle treated with ART[®]

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Objective: To present the diagnostic features and response to treatment of an unreported clinical entity, first dorsal interosseous myofasopathy mimicking turf-toe.

Clinical features: The salient features include an insidious onset of pain in the first MTP joint which compromises forceful propulsion in the absence of ecchymosis and joint effusion. Range of motion may be restricted in both instances, however muscular palpation and resisted manual muscle testing will reproduce the patient's complaints and isolate the first dorsal interosseous muscle as the culprit versus the fibrous plantar plate and joint capsule.

Intervention and outcome: Treatment involves eliminating inflammation, reducing muscular hypertonicity, and restricting the offending activity. Active Release Technique[®] was utilized to remove adhesions and promote the restoration of normal tissue texture with excellent results. No other soft tissue treatment methods were implemented. Alternatively, other soft tissue techniques or modalities aimed at reducing inflammation and pain (i.e. ice, IFC, gentle stretching, etc. ...) may be useful.

Conclusion: Although the etiology and epidemiology of first dorsal interosseous myofasopathy mimicking turf-toe has yet to be elucidated the clinical implications regarding misdiagnosis and treatment are extremely **Objectif** : Présenter les caractéristiques diagnostiques et la réaction au traitement d'un cas clinique non déclaré de myofasopathie interosseuse de la première dorsale présentant les mêmes symptômes qu'une inflammation de l'orteil (turf-toe syndrome).

Caractéristiques cliniques : Les caractéristiques principales incluent une douleur insidieuse au niveau de la première articulation métatarsophalangienne compromettant la puissance de la propulsion en l'absence d'ecchymose et d'épanchement articulaire. L'amplitude du mouvement peut être limitée dans les deux cas, mais une palpation musculaire et des tests manuels de résistance musculaire permettent de reproduire les plaintes du patient et d'isoler le muscle interosseux de la première dorsale comme étant le coupable et non pas la plaque fibreuse plantaire et la capsule articulaire.

Intervention et résultat : Le traitement implique l'élimination de l'inflammation, la réduction de l'hypertonicité musculaire et la limitation de l'activité fautive. L'Active Release Technique[®] a été utilisée pour éliminer les adhérences et stimuler avec d'excellents résultats la restauration de la texture normale des tissus. Aucune autre méthode de traitement des tissus mous n'a été mise en œuvre. Par ailleurs, d'autres techniques ou modalités sur les tissus mous visant à réduire l'inflammation et la douleur (glace, IFC, légers étirements, etc.) peuvent s'avérer utiles.

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important to allopathic and chiropractic practitioners alike. (JCCA 2003; 47(1):28–32)

KEY WORDS : case report, myofasopathy, first dorsal

interosseous muscle myofascitis/diagnosis/treatment,

human, active release technique.

Conclusion : Même si l'étiologie et l'épidémiologie d'une myofasopathie interosseuse de la première dorsale présentant les symptômes d'une inflammation de l'orteil demeurent un mystère, les implications cliniques concernant un mauvais diagnostic et un traitement sont extrêmement importantes aussi bien pour les allopathes que pour les chiropraticiens. (JACC 2003; 47(1):28–32)

MOTS CLÉS : rapport de cas, myofasopathie, muscle interosseux de la première dorsale, myofasciite, diagnostic et traitement, humain, Active Release Technique.

Introduction

Myofasopathy of the first dorsal interosseous muscle is an unreported clinical entity which has extensive implications with respect to physical examination and treatment. This condition very closely resembles traditional turf-toe in terms of symptomatology, however it does not involve an insult to the fibrous dorsal plate or capsule.

It is important to be cognizant of the possibility that myofasopathy rather than turf-toe may be responsible for first MTP joint pain. Accurate diagnosis of this condition lends itself to a markedly different treatment plan focused on reducing muscular inflammation and overuse. Therapy aimed at minimizing capsular insult will not be effective in resolving a myofascial complaint, therefore prolonging the patient's symptoms.

This paper will highlight the course of first dorsal interosseous myofasopathy in two patients, examine the necessity for and means to an early diagnosis, as well as the treatment recommendations for this condition.

Case report

Case 1

A 25-year-old male professional football player presented after 1 week of pre-season training camp with pain in the first metatarsophalangeal (MTP) joint of his left foot. The pain, which had progressively worsened since its insidious onset five days ago, was characterized as sharp and was aggravated by flexion and extension of the great toe. Rest, ice, non-steroidal anti-inflammatories and taping (to minimize joint motion) decreased his discomfort while walking and running, particularly during toe-off, increased it. The patient noted his toe to be particularly stiff and painful upon waking in the morning and after vigorous exercise. He also recalled several previous occurrences of similar symptoms, identical in onset and character, which were treated with a similar protocol as outlined above but with only minimal success. No numbness, tingling or weakness was present in the foot. The patient denied previous surgery or overt trauma to his foot and ankle, as well as any family history of arthritic diseases or associated signs and symptoms.

Upon inspection, there was no ecchymosis and the first MTP joint did not appear to be inflamed when compared to the opposite foot. The patient also displayed bilateral pes cavus, for which he has never sought treatment. All active ranges of motion in the ankle joints were full bilaterally, while flexion and extension were limited in the left great toe due to pain. Passive range of motion, which was also limited by patient discomfort particularly at endrange in both the first and second MTP joints, was able to reproduce the patient's chief complaint. The joint capsules were not tender to palpation with the exception of the plantar and medial aspects of the first toe. Joint palpation revealed rotational, lateral glide and long axis restrictions of the first and second toes, as well as long axis restrictions of the ankle mortise and subtalar joints. Resisted abduction medially of the second toe reproduced the patient's pain, as did the palpation of the first dorsal interosseous muscle, which was boggy in texture. The aforementioned muscle was graded as 4/5, while all other intrinsic foot muscles were graded as 5/5 with manual muscle testing.

The patient was diagnosed with myofasopathy of the first dorsal interosseous of the foot mimicking turf toe. He was treated before practice with five passes of Active Release Technique[®] to the affected muscles and joint capsules respectively and chiropractic adjustments to mobilize any joint restrictions. It was also recommended that he be cast for orthotics, however the patient declined. In total, he was seen three times before complete resolution of his symptoms and did not experience an exacerbation for the remainder of training camp and the regular season.

Case 2

A 29-year-old professional football player presented with bilateral foot pain which began without incident 3 days prior during pre-season training camp. His symptoms were exacerbated with blocking maneuvers which forced him to assume a staggered foot stance in which he bore his body weight solely on the balls of his feet. He described the pain as sharp and localized it to the first MTP joints of both feet. The patient also denied any trauma, surgery, family history of arthritic diseases, and associated symptoms.

The patient had no apparent inflammation or bruising of either toe, and was able to actively negotiate and tolerate passive testing of all ranges of motion of the ankle and foot in full with the exception of great toe extension bilaterally, which was limited by discomfort. Resisted muscle testing involving medial abduction of the second digit along with manual palpation reproduced the patient's symptoms and revealed weak (4/5), boggy and painful first dorsal interosseous muscles bilaterally. Restrictions in long axis were found in both subtalar and first MTP joints, with the addition of medial and lateral rotation and medial glide in the latter joint bilaterally.

The patient was diagnosed with bilateral myofasopathy of the first dorsal interosseous of the foot mimicking turf toe. His treatment consisted of Active Release Technique[®] to the affected muscles and joint capsules, chiropractic adjustments to mobilize any joint restrictions, and restrictive taping to minimize first MTP joint extension. Orthotics were also recommended for this patient, however the patient declined. A total of five visits were necessary before complete resolution of his symptoms without exacerbation.

Discussion

According to the American Orthopedic Foot and Ankle Society, turf toe is a "plantar capsule ligament sprain",¹ however an appreciation of surrounding tissues and the extent to which they are damaged is both reasonable and appropriate. This sets the stage for a broader spectrum not only of injury severity but also of contributing anatomical structures as well.^{2,3}

Given the paucity of stability afforded morphologically by the shallow acetabular-like cavity of the hallucal MTP joint it must rely upon the musculotendinous and capsuloligamentous restraints for strength.^{2,4,5} Of particular importance are the medial and lateral collateral and metatarsosesamoid suspensory ligaments and the thick and fibrous plantar plate.^{2,4,5} The later, which is attached firmly to the proximal phalanx and loosely to the metatarsal neck through the capsule, also serves as an attachment for the superficially positioned split tendons of the flexor hallucis brevis muscle after they envelop the medial and lateral sesamoids.⁴ Dynamic stability is provided primarily via three intrinsic muscles: the adductor hallucis laterally, the abductor hallucis medially, and the extensor hallucis brevis dorsally, all of whose tendons insert and blend into the MTP joint capsule.^{2,4} While they contribute more in terms of mobility than support, the flexor and extensor hallucis longus muscles traverse the first MTP joint as well.⁵

The inability for direct anatomical connections of the first dorsal interosseous muscle of the foot overshadows its significance in terms of biomechanics and clinical pathology. Its bi-pennate fibers originate from the first and second metatarsals and insert into the base of the proximal phalanx of the second toe.^{6,7} In an open kinetic chain it functions to abduct the toe, flex the metatarsophalangeal joint and possibly assist in extension of the interphalangeal joints, yet its contribution to bipedal gait is much more impressive.^{6,7} The interosseous muscles are most active during the late midstance and propulsive phases of gait during which time they serve two important functions - firstly, since they lie below the transverse axis of the MTP joints they, in conjunction with the lumbricals, aid in maintaining extensor rigidity of the toes; and secondly they preserve the integrity of the forefoot via ap-

proximating the toes and assist in adaptation to variations in terrain.^{6,8,9} The first MTP joint is subjected to more than twice as much force as compared to the other toes, totaling approximately 40% to 60% of the total body weight.² These loads can double or triple during jogging and running and approximate eight times body weight during a running jump.² While a substantial burden is placed upon the first MTP joint, the remainder of the force is transmitted to the lesser toes which are less capable anatomically to cope with such stresses. Certain athletes, such as football linemen, who are required to spend an inordinately large amount of time in a toe-off position attempting to propel themselves forward are eccentrically resisting MTP joint extension. Such sustained contractions result in musculotendinous damage, particularly in an untrained or detrained individual. The release of chemical inflammatory mediators in response to muscles damage as well as the buildup of lactic acid and metabolic byproducts has been proven to decrease muscular performance and induce a subjective sensation of pain. One of the primary goals of training camp is to establish muscular and cardiovascular endurance in the players since in the off-season they undergo detraining. The two football players in this case both reported experiencing the onset of symptoms within the first few days of training camp during which time they were unaccustomed to the physical demands placed upon them. Although the great toe is not traditionally thought of as a referral pattern for the first dorsal interosseous muscle, the possibility does exist for several reasons. The origin of the first dorsal interosseous muscle is quite diverse and varied, receiving slips from the peroneous longus, second dorsal interosseous muscle and flexor hallucis brevis, in addition to the ligamentous meshwork surrounding the metatarsal bases and cuneiforms.^{10,11} Of interest is the fact that the flexor hallucis brevis referral pattern includes the entire great toe, primarily the medial and plantar aspects of the first MTP joint.¹² It is possible that excessive use of the first dorsal interosseous could translate into damage of the flexor hallucis brevis due to the interdigitating of fibers, or vice versa.

A study published by Rodeo et al. evaluated 80 professional football players in order to ascertain the incidence and causative factors responsible for turf-toe.¹³ They found that 45% of the players (N = 36) had incurred turf-toe, however a statistically significant difference between players who sustained injuries on natural grass versus artificial

turf and players who had pes planus versus a normal arch was not reached.¹³ They also found that offensive lineman, running backs and tight ends had a higher incidence, and that increased ankle dorsiflexion was significantly related to an increase in incidence.¹³ In addition, shoe type, pes cavus, hallux varus, hallux valgus and length of the second toe were not significantly related to the incidence of turf-toe.¹³ Nigg and Segesser cited increased frictional forces inherent to artificial turf rather than a decline in resiliency as the causative agent.¹⁴ Clanton et al. investigated the possibility that an increase in the stiffness of artificial turf was a causative factor but found no significant association, however they suggested that the increased flexibility afforded by the soccer-style shoes now being worn on synthetic fields was responsible for the increase in incidence.¹² An increase shoe pliability would lead to an increase in the magnitude of perturbation being applied to the foot, ultimately necessitating an increased muscular effort to achieve the same amount of stability thereby creating the possibility of an overuse injury. Of interest is the paper by Rodeo et al. which did not reach statistical significance with respect to shoe type, however less than 19% of the participants in that study wore the seven cleat grass shoes, possibly confounding the result. Due to the diagnostic dilemma first dorsal interosseous myofasopathy presents, and the fact the mechanism by which it mimics turf-toe has yet to be elucidated, information regarding incidence, prevalence and causative factors is not available.

The salient feature for diagnosing this condition with respect to history appears to be an insidious onset of pain in the great toe, which compromises the ability for toe off and forceful propulsion. Traditional cases of turf-toe are usually the result of a single definitive episode involving hyperextension of the first MTP joint.^{1,4,15,16} The initial discomfort steadily increases over the ensuing hours and may not reach maximal levels until twenty-four hours post-injury.³ From the standpoint of physical examination, the first MTP joint becomes swollen and tender to palpation in turf-toe, while the overlying skin may exhibit signs of ecchymosis and hyperemia.^{1,4,15,16} This is in contrast to myofasopathy where the joint presents without said findings. Range of motion may be restricted in both instances, however muscular palpation and resisted testing will isolate the first dorsal interosseous muscle as the culprit versus the fibrous plantar plate and joint capsule.

Treatment for this condition involves eliminating or

diminishing the offending activity, decreasing the inflammation from and reducing the hypertonicity of the effected muscle. A rigid orthotic placed in the patient's shoe to limit the extremes of metatarsophalangeal joint extension is employed in traditional cases of turf-toe, however its effectiveness in treating myofasopathy, while plausible, has yet to be determined. As mentioned previously Active Release Technique[®] was utilized with excellent results therefore no other soft tissue treatment methods were implemented. Alternatively, modalities aimed at reducing inflammation and pain (i.e. ice, IFC, gentle stretching, etc. ...) may also be of use to the practitioner who is not certified in the aforementioned technique.

Conclusion

The crucial elements in correctly diagnosing first dorsal interosseous myofasopathy include an insidious onset, absence of bruising and significant swelling, restricted ranges of motion and muscular pain induced via palpation and resisted testing with referral to the first MTP joint. Lesions of the dorsal fibrous plate or capsule, as in turftoe, are usually the product of a single traumatic event resulting significant first MTP effusion and ecchymosis. Treatments aimed at reducing inflammation and muscular hypertonicity, such as Active Release Technique[®], in conjunction with modifying biomechanical factors to minimize MTP joint hyperextension appears to resolve this condition rapidly. A paucity of first dorsal interosseous myofasopathy information necessitates further study to uncover the precise etiology, epidemiology and incidence of this condition.

References

- 1 Tewes DP, Fischer DA, Fritts HM, Guanche CA. MRI findings of acute turf toe: a case and review of anatomy. Clinical Orthopedics and Related Research 1994; 304:200–203.
- 2 Clanton TO, Ford JJ. Turf toe injury. Clinics in Sports Medicine 1994; 13(4):731–741.
- 3 Bowers KD, Martin RB. Turf-toe: A shoe-surface related football injury. Medicine and Science in Sports Exercise 1976; 8(2):81–83.
- 4 Watson TS, Anderson RB, Davis WH. Periarticular injuries to the hallux metatarsophalangeal joint in athletes. Foot and Ankle Clinics 2000; 5(3):687–713.
- 5 Frey C, Andersen GD, Feder KS. Plantarflexion injury to the metatarsophalangeal joint ("Sand Toe"). Foot and Ankle International 1996; 17(9):576–581.
- 6 Moore KL. Clinically Oriented Anatomy. Baltimore: Lippincott Williams & Wilkins, 1998.
- 7 Kendall FP, McCreary EK, Provance PG. Muscles: Testing and Function 4th Edition. Baltimore: Williams and Wilkins, 1993.
- 8 Michaud TC. Foot Orthoses and Other Forms of Conservative Foot Care. Thomas C Michaud, Newton MA, 1997.
- 9 Travell JG, Simons DG. Myofascial Pain and Dysfunction: The Trigger Point Manual. Volume 2: The Lower Extremity. Baltimore: Williams and Wilkins, 1992.
- 10 Akita K, Niiro N, Murakami G, Sato T. First dorsal interosseous muscle of the foot and its innervation. Clinical Anatomy 1999; 12(1):12–15.
- 11 Kalin PJ, Hirsch BE. The origins and function of the interosseous muscles of the foot. J Anatomy 1987; 152:83–91.
- 12 Clanton TO, Butler JE, Eggert A. Injuries to the metatarsophalangeal joint in athletes. Foot and Ankle 1986; 7(3):162–176.
- 13 Rodeo SA et al. Turf-Toe: An analysis of metatarsophalangeal joint sprains in professional football players. Am J Sports Med 1990; 18(3):280–285.
- 14 Nigg BM, Segesser B. The influence of playing surfaces on the load on the locomotor system and on football and tennis injuries. Sports Med 1988; 5(6):375–385.
- 15 Sammarco GJ. Turf Toe. Instructors Course Lectures 1993; 42:207–212.
- 16 Hockenbury RT. Forefoot problems in athletes. Medicine and Science in Sports and Exercise 1999; 31(7 Suppl.):S448–458.